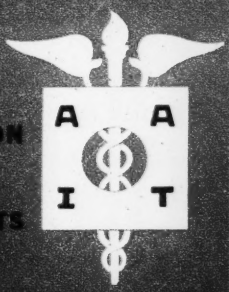
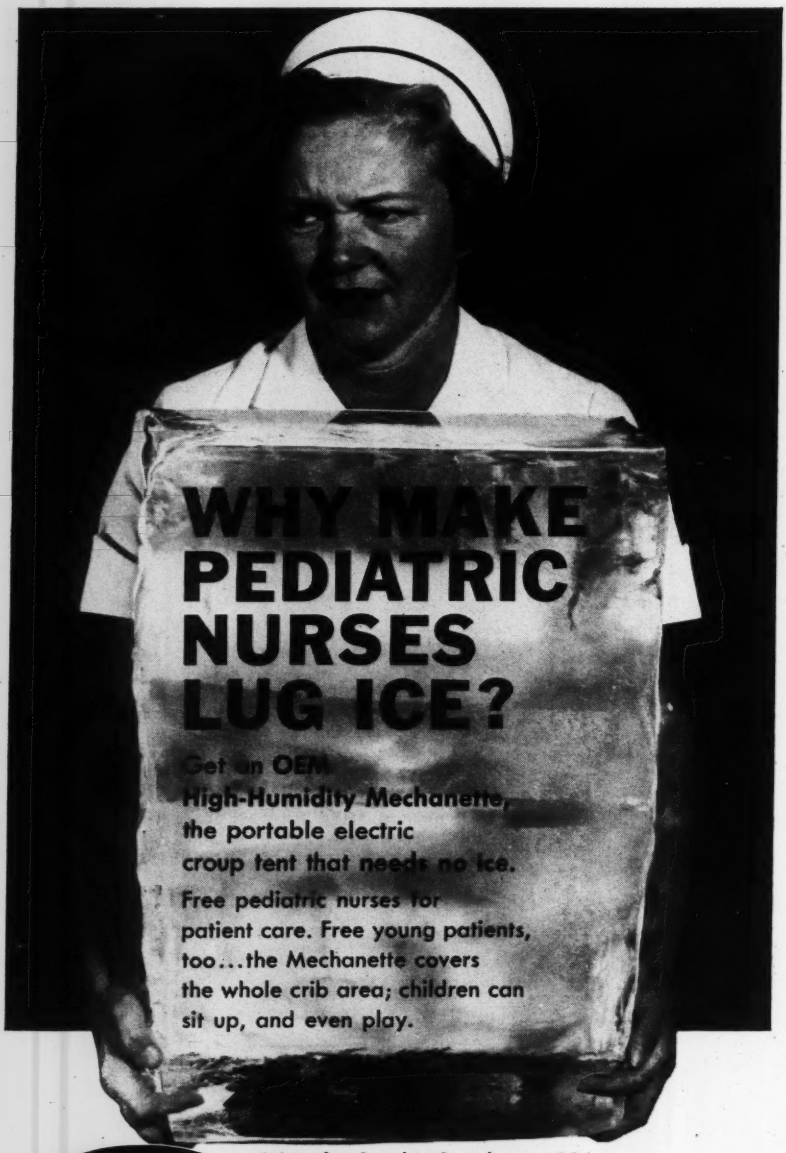
Inhalation Therapy

JOURNAL OF THE
AMERICAN ASSOCIATION
OF
INHALATION THERAPISTS

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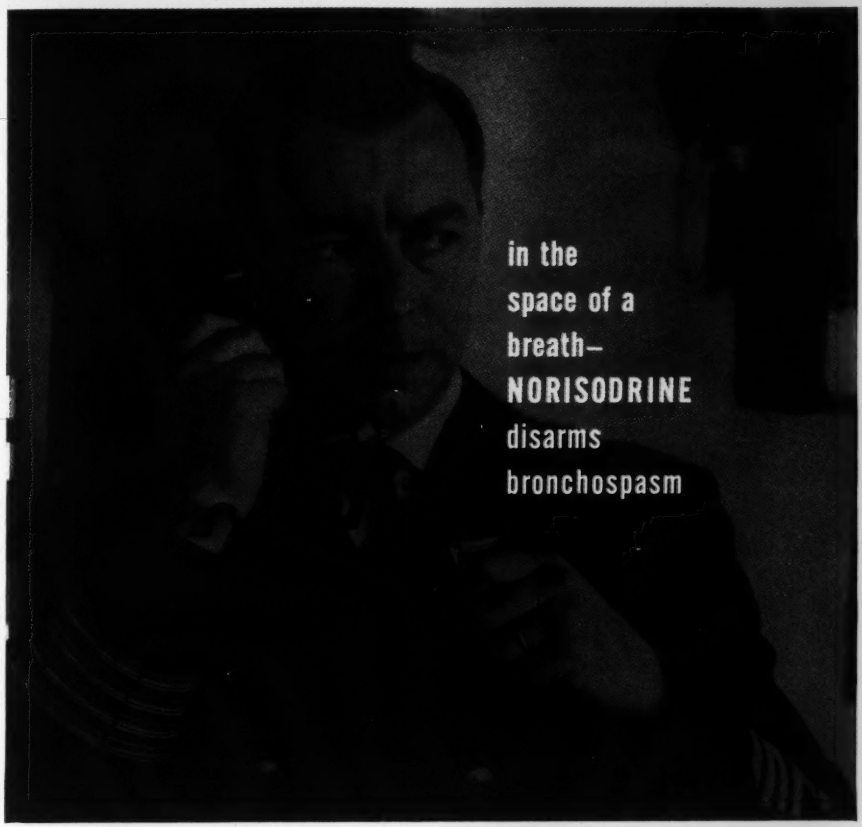

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"Inhalation Therapy"

"Inhalation Therapy" is the official publication of the American Association of Inhalation Therapists, an organization of therapy technicians working in hospitals, for firms providing emergency therapy service and for municipal organizations. The Association is sponsored jointly by the American College of Chest Physicians and the American Society of Anesthesiologists. Contents include news and information pertinent to the profession including medical research, operative techniques, and practical administration.

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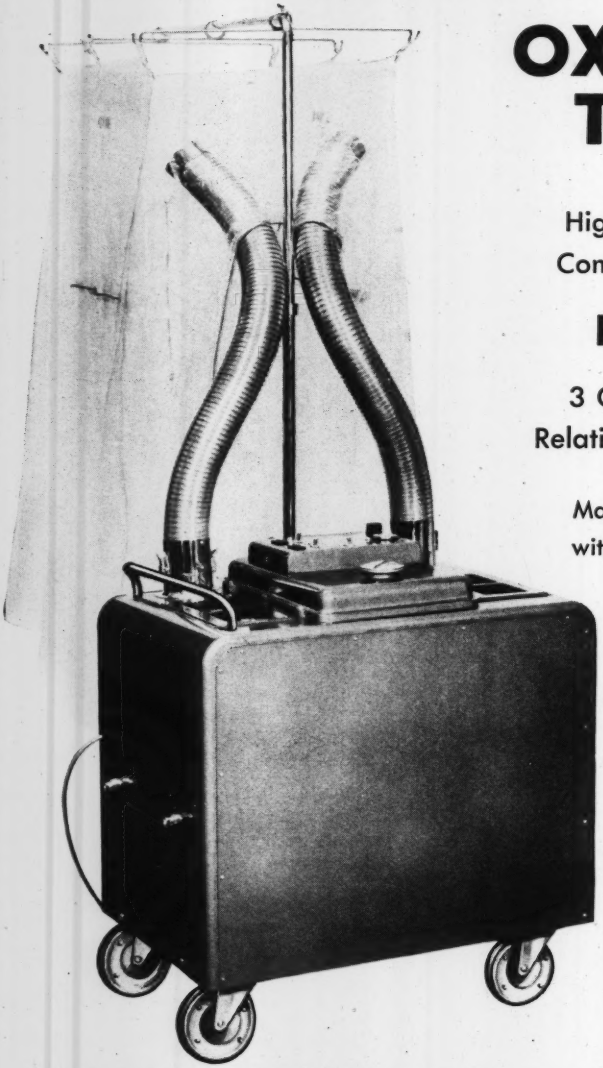

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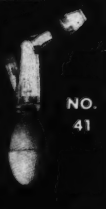

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Editorial

The Challenge

EVERY member of the American Association of Inhalation Therapists is no doubt aware of the tremendous growth of our organization. This is the result of a widened interest in inhalation therapy, the wise leadership of Albert Carrière, our executive director, and the hard work, devotion, guidance and self-sacrifice of many of our members.

Each of us has a job to do for his organization as much remains to be accomplished. It is the responsibility of all of us to work for the improvement and continuation of high standards and education of inhalation therapists and the welfare of the patient. Being a young organization, we have the enthusiasm, energy and courage to forge ahead under wise leadership.

There have been trials and tribulations too numerous to mention, and without the counsel of Attorney Arthur Fitzgerald, who has since gone to his eternal reward, we would have fallen by the wayside. He recognized the need for such an organization as ours and foresaw many of the problems in this field.

Each member should pledge himself always to maintain the high ethical standards of the Association. Ours is truly a democratic organization whose success and growth depend upon the contribution of each member. Only by wholehearted cooperation can continuous growth be expected. It is the responsibility of every member to procure

more members, because by an increase in good membership, we grow in strength and professional status. We, as members, must: (1) keep abreast of the newest trends, techniques and equipment, so that we can intelligently perform our job, (2) gain the confidence of our doctors, and above all, (3) give the best inhalation therapy to the patients so that they are given a new lease on life.

I received a letter this week from a member requesting literature. He told me that he wants to become an *outstanding* inhalation therapist. This challenge faces all of us. If we all keep this goal in mind our organization is sure to prosper.

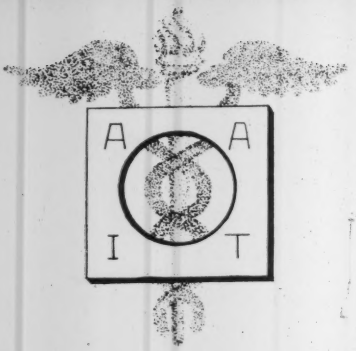
Every hospital would do well to put on an educational program periodically and have well-known chest physicians and surgeons lecture on inhalation therapy. In this way, the importance of our work is brought to the attention of the medical profession and the administrators. We have started such a program at St. John's Hospital, Springfield, Illinois. Recently, Dr. Edwin R. Levine of Chicago's Edgewater Hospital lectured to our nurses on "*Inhalation Therapy*." He also lectured at a medical staff meeting, on this all-important work of our organization. Prior to the meeting, an oxygen therapy manual, recently printed by St. John's Hospital, was given to each attending physician. Much enthusiasm concerning the manual has been shown by all the medical men. Our inhalation therapy treatments have more than doubled, and many patients have been helped. Such a program also provides an excellent opportunity to procure future inhalation therapists.

It is indeed gratifying to see the interest being shown inhalation therapy by chest physicians, anesthesiologists and the American Medical Association.

Those who have the future of the American Association of Inhalation Therapists at heart will realize that no professional specialty can maintain itself on the basis of "service" alone, but rather by the words of wisdom passed along by those who lead and inspire us. Without vision and research, the professions die.

In unity there is strength. If inhalation therapy is to meet the challenge, the abilities and energies of every member should be welded together to bring to suffering humanity the very best service possible in inhalation therapy. Our greatest reward is the knowledge that we are doing our best to help mankind.

—Sister M. Rudolpha



200 expected at annual meeting

SOME 200 inhalation therapists, doctors, nurses, equipment manufacturers, and service company representatives are expected to attend the fourth Annual Meeting and Lecture Series of the American Association of Inhalation Therapists.

The meeting will be held at the Hotel Ambassador in St. Louis, Missouri, November 10 through the 14.

The program will include lectures, panel and group discussions, an orientation for new attendees, a field trip to a pulmonary laboratory, a "get-acquainted hour," special sessions for service company members, equipment clinics for service members and manufacturers, and, of course, the usual annual business meeting for reports and the election of officers.

Topics of special interest will include: The physiologic basis for inhalation therapy, the therapist's place in his organization, the use of high humidity and aerosols, pulmonary function tests, long-term therapy, IPPB therapy, the history and future and sponsorship arrangement of the AAIT, gas mixtures, the role of industry in inhalation therapy research, safety and record standardization.

Too, there will be significant sessions on standards of education and training and the establishment of schools, and the legal problems connected with inhalation therapy.

The opening day's session (Monday, the 10th) will begin with orientation for those who have not before attended an annual meeting.

Then Dr. Edwin R. Levine of Edgewater Hospital, Chicago, will speak on the *"Physiologic Basis for Inhalation Therapy."* Dr. Arthur W. Neilson, president of the St. Louis Medical Society, will welcome the registrants at the noon luncheon.

Therapists will speak

In the afternoon there will be a session on *"The Therapist's Place in His Organization"*. Sister M. Blanche, O.S.F. of Good Samaritan Hospital, Zanesville, Ohio, will discuss *"The Therapist and the Nursing Service"*. James F. Whitacre of Strong Memorial Hospital, Rochester, New York, will speak on *"The Therapist and the Physician"*. And

Larry E. Ross of Baptist Hospital, Nashville, Tennessee, will talk on "*The Therapist and the Anesthesia Department*".

A new feature this year will be a special program for service company members both Monday morning and afternoon. Informal discussions will be held on service company problems, including liabilities, leases and contracts; manufacturer and public relations; record keeping; personnel; supplies; new equipment; deliveries, trucks and piping.

Moderators for this special program will include: M. E. Glasser of Miami, Florida; C. R. Mann of Tampa, Florida; S. B. Pendley of New Orleans, Louisiana; J. Howard Newell of Hammond, Indiana; and William B. Clothier of Wilkes-Barre, Pennsylvania.

Behnke talks Tuesday

Tuesday's general session will open with Dr. Roy H. Behnke of the Veterans' Administration Hospital in Indianapolis discussing "*Breathing Exercises for Chronic Respiratory Cases*". Then Dr. Herbert B. Zimmerman of the Jewish Hospital of St. Louis will talk on "*High Humidity and Aerosols in Inhalation Therapy*", and Dr. Mario B. Pianetto of Robert Koch Hospital, Koch, Missouri will speak on "*Long Term Therapy.*"

At Tuesday's luncheon there will be two speakers. Dr. Edwin Emma, Chairman of the Committee on Inhalation Therapy of the American Society of Anesthesiologists, Inc., will tell "*Why the A.S.A. is Acting as Joint Sponsor for the AAIT.*" Then Sister M. Rudolpha, C.R.N.A., of St. John's Hospital, Springfield, Illinois, will outline "*The History and Future of the AAIT.*"

Tuesday night is set aside for the field trip to Dr. Herbert Sweet's pulmonary laboratory at Firmin Desloge Hospital. Dr. Sweet is director of the pulmonary laboratory at St. Louis University.

Wednesday morning's general session will include these talks:

Dr. George A. Saxton, Jr., of the University of Illinois' respiratory center in Chicago will speak on "*Artificial Respiration Through a Tracheotomy Tube*". John J. Hennessey of the Welding Gas Products Company of Chattanooga, Tennessee, will discuss "*Safety in Oxygen Therapy*". And LeRoy Fortner of National Cylinder Gas will speak on "*Industry's Part in Inhalation Therapy Research.*"

An innovation will be that the annual business meeting will be held on Wednesday starting with the luncheon at which Albert Carrière, executive director of the AAIT, will give his annual report. This will be followed by the report from James Peo, R.N., the AAIT president. Mr. Peo is supervisor of inhalation therapy at Delaware Hospital, Wilmington.

Officers to be chosen

The business meeting will, as usual, include the chapter, committee and treasurer's reports, and election of officers. In other years this meeting has been held on the final day of the convention which meant some people had to miss it.

Thursday's general session will open with Dr. Albert H. Andrews, Jr., of Presbyterian-St. Luke's Hospital, Chicago, speaking on "*Bronchiolitis*".

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RLF . . . Still a Threat to Premies

Only a few years ago, all we heard about was RLF. After everybody found out the importance of using under 40% oxygen or none, and of analyzing incubators to check up on the concentration, RLF began to fade out of the news.

Findings of an eastern survey this spring reveal that laxity is developing with regard to precautions necessary for prevention of RLF. If we do not renew our efforts, this disease will be blinding our children again.

As recently as 1955, more preschool children were blinded by RLF than by any other cause. There were about 650 cases in the United States that year.[1]

First described in 1942, the disease increased during the late 40's and early 50's until 1953, when 181 cases were reported in New York state alone.[2]

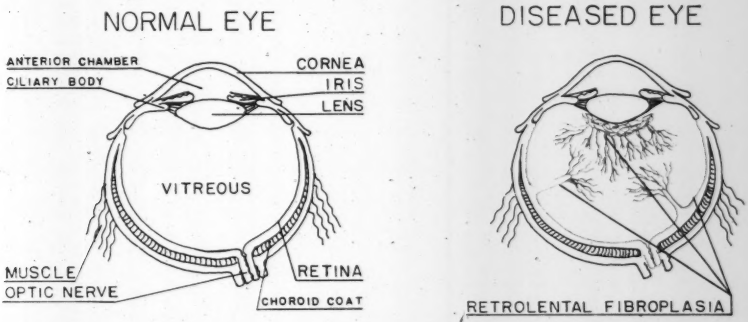
After routine use of oxygen on all premature infants was restricted, the incidence of RLF fell off as dramatically as it had risen—to only 93 cases in New York state in 1955.[2]

Retrolental fibroplasia is the medical term for the formation of a mass of opaque scar tissue behind the lens of the eye. There are probably a number of causes of this condition, but evidently they all involve the effects of oxygen—either too much or not enough—on the developing blood vessels of the premature retina. (No adverse effect of oxygen on the retina can be demonstrated on the matured structure; hence, this phenomenon occurs only with premature infants, and there is no "scare" about giving oxygen to full term infants, children or adults.) Between about six and eight months' gestational age, the retinal blood vessels are at a critical stage of development. During the period in the uterus, the amount of oxygen available to the fetus is less than he will get from air after he is born and begins to breathe. If now the infant is prematurely thrust into the outside world, not fully developed—and especially if he is subjected to a bout of hypoxia during delivery (too many narcotics or anesthetics given the mother)—the effects on the retinal vasculature are very adverse.

Space does not permit a full discussion of the way in which the condition arises, but there evidently are still at least two well-documented schools of thought—one saying it is caused by too much oxygen, which first constricts the vessels and then causes disorganized overgrowth of new ones[4]; the other stating that the effects derive from the *relative* hypoxia which occurs when supplemental oxygen is *withdrawn*, or the oxygen concentration fluctuates in a way which the premature's oxygen-carrying apparatus cannot adapt to quickly enough to prevent retinal damage.[5]

Whichever is the case, the resulting abnormal growth of the vascular and associated tissues out into the vitreous humor and into the area behind the lens (see figures) is reversible only in its very early stages, and usually proceeds inexorably to the formation of an opaque mass behind the lens and often partial or complete detachment of the retina—either of which results in blindness.

There is no cure for RLF, so its prevention is extremely important. And *all* the investigators concur as to what must be done to accomplish this. A number of formal pronouncements have been issued by various authorities, all of which include the following points: (1) No infant should be given oxygen routinely; and doctors should order it only when there is *marked* clinical need. (2) When used, oxygen concentration must be *rigidly* controlled by: (a) use of prepared gas mixtures containing 40% oxygen and the rest nitrogen, or (b) use of specially designed flowmeters that will accurately *measure* and *maintain* constant small flows of the order of only one or two liters per minute, or (c) use of "limiters" or "diluters" which mix air with entering gas and thus prevent oxygen concentration from going over a set value, and (d) frequent use of a reliable gas analyzer to determine percentage of oxygen in the incubator. (3) Duration of oxygen therapy should be as short as possible, but if it has been used more than four of five days or at a high concentration necessitated by poor condition, then the concentration should be tapered downwards over a few days' time instead of abruptly dropping it from, say, 40% to 20% after the child has become acclimatized to the high concentration for a week or more.



Right here is where mechanical perfection of equipment is not enough. Personnel concerned with these babies must be alert and conscientious and informed. The survey recently completed in Connecticut[3] revealed shocking dereliction in this respect. Examples of their findings: (1) "Although only 17 hospitals (out of 35) were using mixing valves, 11 others had them available in the nursery or storeroom, but were not using them because they were considered un-

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Drawings are reproduced from Dr. Letourneau's article with permission of **Hospitals, J.A.H.A.** (see references).

Oxygen therapy—an unsuspected source of hospital infections?

by C. R. Macpherson, M.D.

OXYGEN, as an essential part of modern therapy, has been extensively investigated, but bacteriological study of the apparatus used in this form of therapy seems to have been neglected. A review of the available literature on oxygen therapy in general and on humidification apparatus in particular has failed to provide any information on this aspect other than general statements, such as, "The entire unit can be dismantled and sterilized in an autoclave."[1] Even where such statements are made, no reason is given for this use of the autoclave, other than the general, obvious, and unspoken one that all therapeutic apparatus should be clean.

This investigation was accordingly undertaken to determine three things: 1. In the efficient, well-run oxygen therapy unit of a modern teaching hospital, is contamination of the apparatus a real factor or only an imaginary hazard? 2. If contamination does exist, does it involve pathogenic organisms or only harmless saprophytes? 3. If contamination by pathogenic organisms is a real hazard, what modifications in procedure would be necessary to ensure sterile, or near sterile operation?

Materials and Methods. Since no investigations had been reported, it was necessary to improve and test methods of sampling, as well as to decide which pieces of apparatus, and how many parts of each piece, required investigation.

The figure shows a humidifier (Oxifier) of the type which comprised about 85% of the humidifying apparatus in the hospital at the time this investigation was begun. The several other types of apparatus in use need not be considered further, since they presented similar problems in sampling and the findings were essentially the same as those reported for this type.

The attachment and pressure-release valves (Figure, A and B) were sampled with a swab moistened in sterile saline solution. Tubes of thioglycollate glucose broth were then inoculated and in-

---

Doctor Macpherson is chief of the Division of Bacteriology, Department of Pathology, The Ohio State University, Columbus, Ohio.

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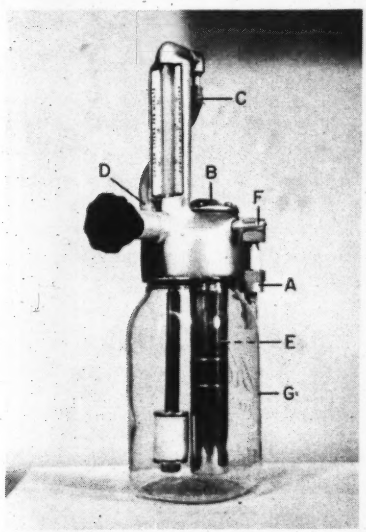
cubated at 37°C for four days. The water reservoirs were tested by removing five ml. of water with a sterile pipet. This was then either cultured in a flask containing thioglycollate glucose broth or else used for plate counts.



Humidifying apparatus in general use at time of investigation: A, attachment to wall outlet; B, pressure-release valve; C, flowmeter outlet tubing, upper end; D, flowmeter outlet tubing, lower end; E, tube to outlet with baffle-plate at top; F, patient outlet; G, glass reservoir.

The oxygen coming into and leaving the humidifier and the outlet ducts in the humidifier could not be tested by these techniques. The system devised was based on the use of sterile tubing to bubble oxygen through a culture medium. Standard Bunsen tubing was cut into 10-inch lengths, placed in individual paper wrappers which were stapled shut, and put into an autoclave at 15 lb. of pressure for 20 minutes. This ensured a supply of sterile tubing which was easy to prepare and store. The medium used throughout was thioglycollate glucose broth. Fifty-milliliter amounts were placed in six-ounce, round, screw-capped bottles and put into the autoclave. When the incoming oxygen was being tested, the sterile tubing was attached to the connection at the upper end of the flowmeter (Figure, C). The other end of the sterile tubing was placed just below the surface of the medium in the bottle and the oxygen run at exactly five liters per minute for exactly four minutes, thus ensuring each time that a comparable sample of 20 liters of oxygen was tested. There was no con-

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A humidifying device typical of the apparatus generally used in connection with oxygen therapy was studied bacteriologically as a possible source of contaminant organisms in the hospital. Samples of water taken from the reservoirs of the humidifier revealed a marked degree of contamination in a large percentage of cases. Although most of the bacteria found were nonpathogenic, a few were dangerous, and the extent of contamination was greater than had been anticipated. As a result, a systematic procedure for the care of humidifying units in oxygen therapy has been adopted. The water to be used must be sterile, and when the level of the reservoir falls, the residue must be discarded and replaced, not merely replenished. Certain policies regarding sterilization should be followed, and after each period of use, the glass reservoir must be cleaned and inspected before the unit is used again or stored.

Trachea must be kept clear for successful oral resuscitation

AFTER centuries of progress, the Biblical breath of life (mouth-to-mouth resuscitation) has been found superior to modern scientific methods after all.

However, modern knowledge of the importance of keeping the airway open while applying *any* form of artificial respiration is something which has apparently escaped practically everybody from Elisha down to present times.

Brief consideration of the anatomy of the upper airway (Fig. 1) shows why conscious effort must be made to ensure patency of the passage. In the unconscious person—especially the one on his back—the tongue falls back and blocks the trachea—often completely (1-A). If artificial respiration of any sort is undertaken without first correcting this condition, the effort will fail.

By the simple expedient of straightening out the passage (by tipping the head back) and pulling the jaw forward (1-B), the tongue is gotten out of the way. It should be emphasized that it will not stay that way, and the operator must constantly hold the head and jaw in this position to ensure patency during resuscitation.

Note also that insertion of an oral airway does *not* automatically ensure a patent airway. The oral airway reaches just to the base of the tongue, so it is still possible with the chin down close to the chest (as in 1-A) for the epiglottis to cover partially or almost completely the entrance to the trachea. It is therefore necessary with either mouth-to-mouth or mouth-to-airway methods to tip the head back and pull the jaw forward until there is partial dislocation of the joint, as shown in Fig. 1-B.

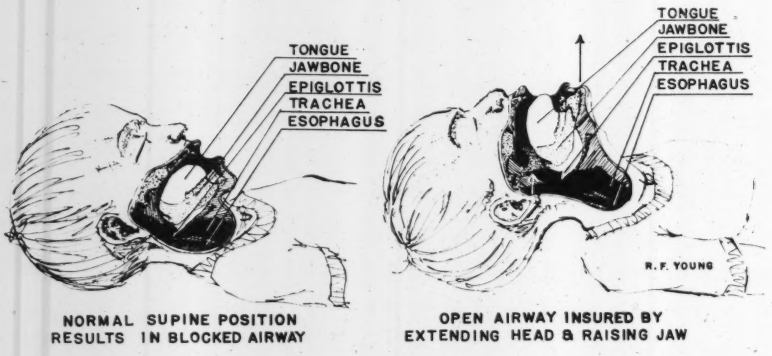


Fig. 1

The American Medical Association has issued an excellent symposium on Mouth-to-Mouth Resuscitation (*J.A.M.A.*, May 17, 1958, pp. 317-41) which all inhalation therapists should become familiar with. Space limitations in this journal preclude reprinting it, but much of the information has appeared in other journals and is being spread by films, demonstrations and other channels. We are therefore only briefly summarizing the two chief variations, and fuller information should be sought in the symposium referred to above, or in the original sources it cites.

MOUTH-TO-MOUTH

Fig. 2

MOUTH-TO-AIRWAY

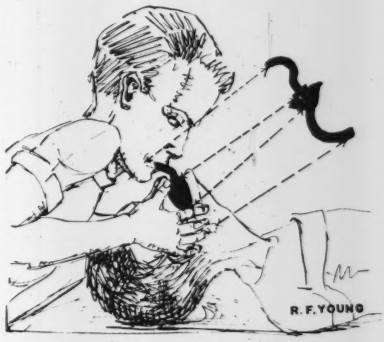


Fig. 3

1. Clean out patient's mouth with fingers.

2. Extend his head and pull jaw forward with one hand; pinch his nose with other hand.

3. Firmly cover all of his mouth with your own.

2. Extend his head and pull jaw forward with fingers of both hands, closing his nose with thumbs.

3. Insert airway—do not push back his tongue! Place your mouth over free end of airway.

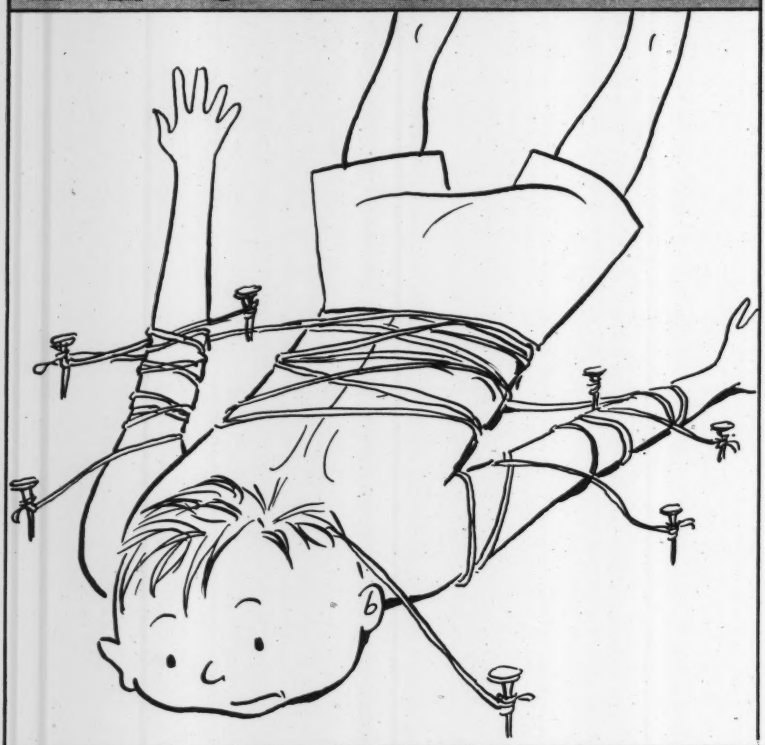
4. Take a deep breath and blow into his lungs—forcefully for adults; gently for children.

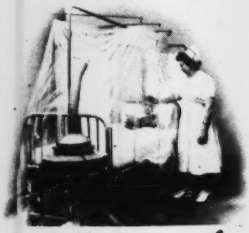
5. Watch his chest, and when it rises, remove your mouth to let him exhale.

6. Repeat about 20 times per minute.

Note: S-shaped airways used for the mouth-to-airway method of resuscitation are made in easy-to-keep-clean plastic and are available from medical supply firms. The responsible therapist should equip himself with one of these inexpensive airways and carry it at all times while on duty.

freedom.





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How to stop budget leaks

by Don E. Gilbert

THERE'S one sure and effective way to stop budget leaks in your inhalation therapy department: Keep accurate and complete records on all equipment—its cost, use, location and maintenance!

A classic example is an experience we had in our inhalation therapy department at the University of Michigan Medical Center. We had completed our statistical totals for the month of January. These showed a fairly large revenue increase, and the number of new cases started as well as the daily average of active cases had increased proportionally. This, of course, as would be expected, resulted in additional expenses for commodities. However, the percentage of expenses was out of proportion to the revenue increase.

We first checked over our purchases for the past month; there were no purchases of unusually expensive equipment nor large orders of expendable or "one-time use" equipment. This left, then, only one possible reason for this increase in our expenses, namely, the purchase of oxygen.

Then we began checking back, month by month, our use of oxygen, using as a guide the "rule of thumb" use of oxygen, i.e.:

3 cylinders per patient tent day
2 cylinders per patient mask or catheter day
1 cylinder per week for intermittent and PRN cases

Our purchase of oxygen exceeded this "rule of thumb" guide by many cylinders.

We called all the full time therapists together and discussed this loss in our budget. We believe most people like a challenge, and the men in our department were no exception. We set up a plan whereby, during a usually slack period on the junior night shift, we could use up partially full cylinders (⅛, ⅜ and ¼ full); also, on intermittent or standby cases we could use these small amounts. At the end of February we then compared the two months' use:

	Jan.	Feb.
cylinders purchased	1146	840
new cases	213	208
completed cases	210	205
daily average active cases	23	24
no. of cylinders based on "rule of thumb"	1122	944
loss or saving based on rule of thumb	loss 24	saving 104

This represents a saving in excess of approximately $250.00 per month!

continued on page 40

Mr. Gilbert is inhalation therapy supervisor, University Hospital, Ann Arbor, Michigan.

continued from page 17

stant or reproducible difference in results, whether the oxygen ran at two, four, five, or 6.6 liters per minute. However, the slower rates made sampling very tedious, and faster rates resulted in rather excessive splashing, so that five liters for four minutes was chosen as the best and adhered to throughout.

To sample the condition of the outlet ducts in the humidifier, without interference from organisms carried over from the water reservoir, duplicate reservoirs were filled with water to the usual level, paper covers were attached, and the reservoirs then put into the autoclave. These sterile reservoirs then replaced the regular reservoir, sterile tubing was substituted for the outlet connection, and the sample was taken as described above.

The patient delivery tubing was in six- to nine-foot lengths. It was sampled before and after cleaning by running 10 ml. of the sterile thioglycollate medium into one end, with the other end pinched closed. With both ends pinched closed, the broth was run from one end to the other several times by elevating alternate ends and was then decanted into a sterile test tube for incubation at 37°C for four days.

Results. Testing of the oxygen from the upper flowmeter outlet and from the wall-connection itself showed uniformly sterile cultures, with the exception of an occasional organism which was almost certainly the result of accidental contamination, since completely aseptic sampling technique is virtually impossible. Swabbing of the pressure-release valve gave equally negative results.

As shown in Table 1, the samples of water taken from the reservoirs revealed a marked degree of contamination in a large percentage of cases. The degree of contamination of the outlet ducts was also high, though not so marked as that of the reservoir water, and there was a lack of correlation in the number of organisms recovered from the two sources in individual pieces of apparatus.

The water used in the reservoir bottles was distilled, though not sterile, and it was difficult to understand why there was such a variation in the number of organisms present as well as such a high general level. Further investigation showed that there were four sources of contamination of this water: (1) carboys in which the water was delivered to the hospital, (2) the siphon (rubber and glass tubing) used to withdraw water from these carboys, (3) the bottle used to take water around to the rooms to replenish the reservoirs of the units in operation, and (4) the habit of replenishing the reservoir bottles periodically as long as the unit was in operation for the same patient without first emptying out the remaining water.

It was found that there was no regular, automatic cleaning of the carboys at the source of the distilled water supply. As a result, distilled water only a day old was found in some cases to have a count over 2,000 organisms per milliliter. A simultaneous check of a commercial distilled water advertised as being in "sterilized containers" showed that six carboys had a count of from three to 1,500 organisms per milliliter.

Contamination of the water was easily eliminated by switching to

the use of commercial, sterile, distilled water. Cleaning the outlet ducts of the humidifiers (Figure, E and F) was more of a problem. Several methods were tried. Originally, the ducts were rinsed through with disinfectant, followed by detergent and then by tap water. Next, the detergent was used before the disinfectant, followed by tap water and distilled water rinses. Another method employed was to hook the unit over the edge of a container full of a cationic detergent in such a way that the outlet ducts were below the surface while the release valve and the flowmeter remained dry. The unit was allowed to soak overnight and was then thoroughly rinsed. Finally, when these methods had been proved to be unsatisfactory, the unit was disassembled as far as possible and cleaned with a swab soaked in detergent, rinsed, and reassembled.

All these procedures failed to ensure even a reasonable degree of cleanliness (Table 1), although the percentage of grossly contaminated reservoirs was considerably reduced. It was obvious that use of the autoclave would be the method of choice, but it was hoped to avoid this, since both the pressure-release valve and the flowmeter would be damaged. However, a later model of the same humidifier, the Oxijet, is made from stainless steel, including the release valve, and appears to be suitable for autoclave sterilization.

With regard to the types of organism recovered from the humidifying apparatus in this survey (Table 2), it will be noticed that the majority are Enterobacteriaceae of a type falling under the general designation of "water bacilli," that is, of a type commonly recovered from water supplies and usually nonpathogenic for man. However, a variety of organisms was found, possibly the most alarming of which was a gas-producing Clostridium, finally classified as an atypical Cl. perfringens (Cl. welchii). Fortunately, the apparatus from which this was isolated was not in use. It was on a surgery floor, but there is no record that any patient in that room suffered from gas gangrene. The outlet tubings were, in general, clean, only light growth of Staphylococcus pyogenes var. albus or of diphtheroids being recovered from the washings.

Comment. The results obtained were unexpected. Since the equipment was not routinely sterilized, some contamination was inevitable, but the extent was greater than had been anticipated. Secondly, the oxygen therapy service, to an impartial observer, appeared to compare very favorably with similar services encountered in other hospitals, as regards organization, cleanliness, and concern to improve methods and service. This inevitably raises the question as to what would be found on similar investigation in other establishments. It appears unlikely that conditions are much better elsewhere, from discussions held with people directly concerned with such matters.

With regard to the third question asked at the beginning of this article, before attempting to provide an improved service one must bear in mind several factors. In the first place, the difficulty of obtaining suitably trained personnel being what it is, the system should be as simple and reproducible as possible, to avoid undue expenditure of time by highly trained person-

nel. Secondly, it should not be prohibitively expensive. Thirdly, a careful balance needs to be struck between what is practicable and what is actually required. For example, aseptic technique throughout would not only be prohibitive in terms of both time and money, but it would be quite unjustifiable, since the air of the room itself is always heavily contaminated. However, it is justifiable to aim at a high degree of cleanliness, since the organisms present in the stream of oxygen are being introduced, under conditions favorable for the establishment of infection, into patients whose pulmonary mechanics render them particularly susceptible to infection. Although no accurate figures exist as to the frequency of patient infection resulting from contaminated oxygen therapy apparatus, it was unanimously agreed by all concerned that this final proof was not necessary. The weight of circumstantial evidence was considered sufficient to justify an immediate change in technique.

For these reasons, the following points were adopted in The Ohio State University Health Center: 1. All water used in humidifying apparatus must be sterile. 2. No apparatus can be in service for a patient for longer than one week. 3. The water in the humidifier must be discarded and replaced when the level falls due to use. The humidifier cannot be replenished without first emptying it. 4. Each time service is discontinued, or after a period of one week of service, the glass reservoir must be cleaned with an antiseptic and a detergent and the rubber washer must be carefully inspected. If any cracks are found, the washer is to be replaced. 5. As soon as suitable apparatus is available, the metal top of the humidifier will be put in the autoclave between patients, or after one week, as in point three. 6. All stored apparatus must be dry. The glass reservoirs must be inverted or covered. 7. Wherever possible, disposable tubing should be used, rather than tubing requiring cleaning. 8. Bacteriological spot checks are to be run at regular intervals.

With reference to the last entry in Table 2, the recovery of nonpathogenic mycobacteria in two cases, it should perhaps be emphasized that these were the only two units tested for the presence of Myco. tuberculosis and that they came from another hospital which specializes in the treatment of tuberculosis.

Summary. Systematic investigation of apparatus used in the oxygen therapy section of a large teaching hospital revealed gross contamination in a high percentage. Three main sources of infection were believed to be responsible: (1) contamination of distilled water before it reached the hospital, (2) difficulty in obtaining adequate cleansing of apparatus, and (3) lack of any standard technique specifically designed to prevent contamination.

In view of the lack of previous studies, it is thought that a similar situation may exist in other hospitals. Specific recommendations are made to eliminate the major sources of contamination and include sterilization of the apparatus concerned.

Miss Judith Hiller supplied technical assistance.

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Table 1. Cultures of Humidifier Reservoirs and Outlets

CONTAMINATION OF RESERVOIRS	ORIGINAL SAMPLING	SAMPLING AFTER REVISION OF CLEANING TECHNIQUE
No. of Samples	46	15
Gross*		
No.	27	3
%	59	20
Slight**		
No.	14	10
%	30	67
Total		
No.	41	13
%	89	87
CONTAMINATION OF OUTLETS		
No. of Samples	37	15
Gross		
No.	5	2
%	14	13
Slight		
No.	12	10
%	32	67
Total		
No.	17	12
%	46	75

*Gross contamination determined by visible growth in less than 18 hrs.

**Slight contamination determined by visible growth in more than 18 hrs.

Table 2. Analysis of Organisms Recovered from Reservoirs and Outlets of Humidifier

TYPE OF ORGANISM	NO. OF TIMES FOUND*	% OF TOTAL NO. OF SAMPLES
Achromobacter and alcaligines fecalis	33	29
Pigment-producing bacilli (various types)	14	12.5
Staphylococcus pyogenes var. aureus (coagulase positive)	12	10.5
Diphtheroids	3	2.7
Clostridium perfringens (Cl. welchii)	1	0.9
Bacillus subtilis	3	2.7
Staphylococcus pyogenes var. albus	4	3.5
Pseudomonas aeruginosa	6	5.3
Yeasts and fungi (nonpathogenic)	3	2.7
Streptococcus viridans	1	0.9
Enterococci	1	0.9
Paracolon bacilli	1	0.9
Escherichia	1	0.9
Klebsiella	1	0.9
Nonpathogenic mycobacterium	2	1.8
Sterile Samples	29	26

*More than one organism was recovered from single sample on occasion.

continued from page 13

Larry Fruik of Edgewater Hospital then will discuss "*Greater Efficiency Through Record Standardization*". He'll be followed by a panel on gas mixtures moderated by Dr. Robert B. Dodd of the Washington University School of Medicine, and including these panelists: Dr. Andrews, Dr. William F. Miller of the University of Texas, and Dr. Albert Roos of the Washington University School of Medicine.

At Thursday's luncheon Dr. John Hinman, assistant secretary, the Council on Medical Education and Hospitals of the American Medical Association, Chicago, will give a "*Report on Standards of Education and Training and Establishment of Schools*".

Ten roundtables set

Thursday afternoon Mrs. Leah Tharaldson, R.N. of Northwestern Hospital, Minneapolis, Minnesota, will conduct another of her popular series of roundtables with the registrants discussing in groups: Physical plant, administration and records, general maintenance, the nurses' role, personnel and public relations, schools and in-service training, service members' problems, chapter organization and operation, basic techniques, physiological aspects and medical supervision.

Dr. George Meneely of Vanderbilt University Hospital, Nashville, Tennessee, opens Friday's session by discussing "*Practical Pulmonary Function Testing*"; then Dr. Sweet will talk on "*IPPB Therapy in Emphysema*".

The morning session will close with an educational panel on schools of inhalation therapy. Mrs. Constance T. Cypert of Inter-Community Hospital in Covina, California, will be the moderator and panel members are: Ralph E. Johnson, also of Inter-Community, Mrs. Tharaldson and Walter L. Jones of the U.C.L.A. Medical Center in Los Angeles.

Final meeting Friday

At Friday's luncheon, the final meeting of the convention, John J. Riordan, Chicago attorney, will speak on "*Legal Problems of Inhalation Therapy*". Then Mr. Carrière will sum up the meeting.

Other annual meeting features will include equipment clinics at which service members and manufacturers may discuss specific equipment features and problems; individual breakfasts for industrial and service members; the annual board of directors meeting; conferences for members with the executive director; an exhibit hall displaying in 24 booths the equipment of 21 major manufacturers; and the showing of films by exhibitors.

Fees cover everything

Registration fees for the annual meeting and lecture series are: Members—$40; Non-members—$50. These both cover admission to all sessions, five luncheons, the field trip and the exhibits.

Complete printed programs will be sent to all members with the next issue of the AAIT newsletter.

For additional information write to: Albert Carrière, Executive Director, American Association of Inhalation Therapists, 332 South Michigan Avenue, Chicago 4.

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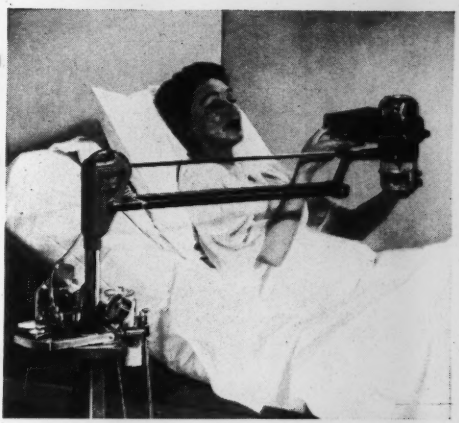

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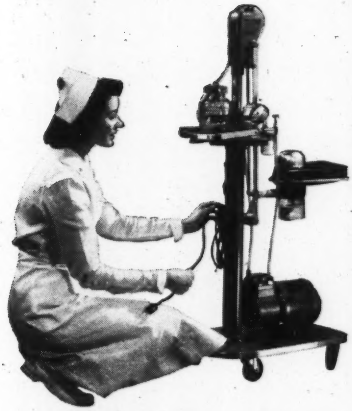

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continued from page 15

necessary or not understood by hospital personnel." (2) Various diluting equipment was found not to be delivering the oxygen concentration set for. Reasons ranged from faulty equipment to failure to clean it or improper reassembly after cleaning. (3) In checking their analyzers, it was found that 32 of the 35 hospitals had them, but only 16 out of 34 of the analyzers were in good working order. Personnel had probably been using these without realizing they were getting false readings—a situation considerably worse than no readings at all. (4) Oxygen was given *routinely to all premies* in six of the 35 hospitals (over 17%).

These findings point the finger clearly at the need for *someone* in every hospital who can see that the nursery (1) has the proper equipment, (2) knows how to use it, and (3) does use it intelligently. This person is logically the inhalation therapist, who should be the most familiar with such equipment, and whose further responsibility it should be at *regular* intervals to inspect and test all such equipment as diluting and limiting devices, gas analyzers, etc. There is also usually nebulizing apparatus associated with such equipment, and the inhalation therapist should show nursery personnel how to keep both diluter venturis and nebulizer jets clean. No venturi will accurately control oxygen concentration after it has sucked in much dust, and neither will the nebulizer make much mist if it is not periodically cleaned and/or adjusted.

However, the final responsibility rests with the nursery personnel, since they are the ones who are administering the therapy and are with the patients all the time.

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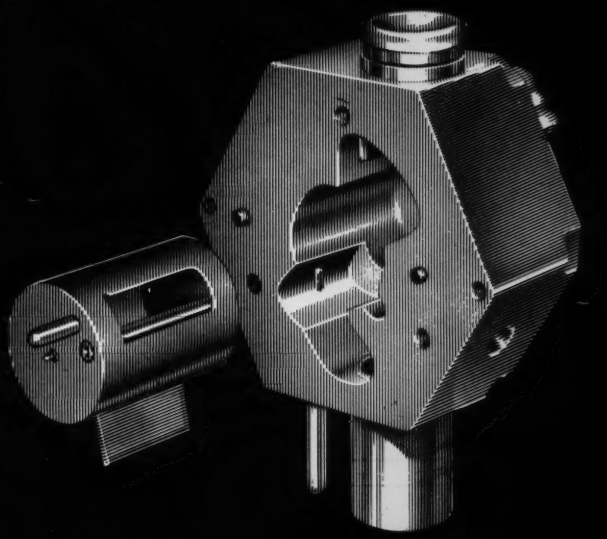

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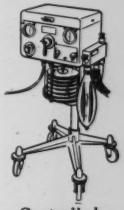

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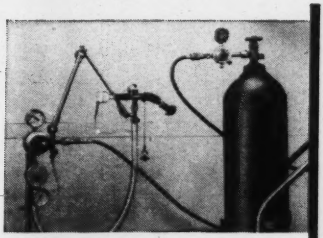

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Officers of the Tennessee Society of Inhalation Therapists are: Seated, Larry E. Ross, president; Standing, left to right, Charles Benson, membership chairman; Joe Vincent, entertainment chairman; Russell Huffman, secretary; Al Munn, Jr., educational director; and John Rewis, vice president.

CHAPTER ACTIVITIES

by Jack Sangster

THE Tennessee Society of Inhalation Therapists' Institute on Inhalation Therapy, which attracted more than a hundred people to Baptist Hospital in Nashville, July 11, was the occasion for presentation of a **Tennessee Chapter** charter to Larry E. Ross, president, by Albert Carrière, executive director of the AAIT.

The program included these speakers and subjects: Dr. Harry Moore, president of the Tennessee State Society of Anesthesiologists, "Development of the Chapter"; Dr. George Carpenter, chief of staff at Baptist Hospital, "Inhalation Therapy"; Dr. Paul Lindsay, "Oxygen Therapy in General Practice"; Dr. Dewey Nemec, "Pediatric Applications of Oxygen Therapy"; Dr. Robert McCracken, "Diseases of the Chest"; Dr. Orie Crouch, "Internal Medicine"; and Gene Kidd, administrator of Baptist Hospital, who showed how adding an oxygen therapy department had relieved many problems of the administration. All of those doctors are advisers to the chapter.

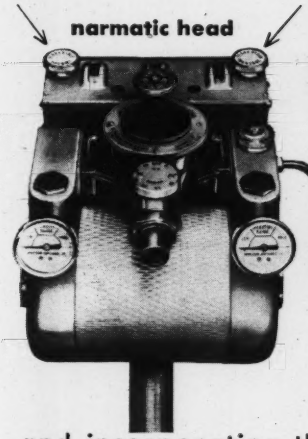
Other officers for this year are John Rewis, vice president; Russell Huffman, secretary; and Walter Wallace, treasurer.

The day was climaxed by a banquet at the Richland Country Club for members, medical advisers and guests.

The annual meeting of the **Upper Mid-West Chapter** was held at the Minneapolis Auditorium on May 15. Seventeen members were present from North and South Dakota, Wisconsin and Minnesota. Following the business meeting, Dr. Edwin R. Levine of Chicago spoke on "Administration of Inhalation Therapy in Acute Respiratory Infection," and Dr. W. R. Schmidt of Minneapolis on "Pulmonary Physiology in Acute Chest Injuries."

Officers for this year: Sister M. Daniel, president; Sister M. Lucide, vice president; and Mrs. Shirley Bell, secretary-treasurer.

Greater New York Chapter meetings have included presentations on CO_2 analyzers, nebulizers, aerosol therapy and home oxygen service.



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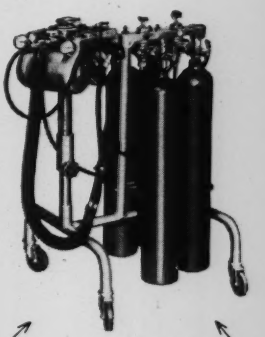

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THE EDITOR'S CORNER

The Problem of Infections

ELSEWHERE (page 16) we are reprinting a distressing article which is of great importance to inhalation therapists.

Dr. C. R. Macpherson's findings, as he says, are probably typical not only of his hospital, but of many others of similar size and organization. Each of us is thereby warned to scrutinize his own department critically to see whether everything that can reasonably be done is being done.

Dr. Macpherson's warning comes at a time when many hospitals already are doing battle with resistant strains of staphylococcus, and the possibility that some of our inhalation therapy equipment could be harboring or passing organisms of this sort on to patients is a very disquieting thought.

Actually, it brings up the whole topic of general cleanliness—of ourselves, of our equipment, and of the areas where we work with and store our equipment. How many of us would feel comfortable about having a surprise visit from a public health or sanitation officer?

In looking over a number of recent papers on staphylococcus infection control, I came across one in the October 1957 *Canadian Journal of Surgery* that had a particularly enlightening photograph, which shows the spread of infection from the nose. The model for the photo had sniffed some fluorescent powder up his nose about six hours before the picture was taken. He had blown his nose several times. The exposure was made by ultra-violet light; hence only fluorescent materials registered on the plate. The model's pocket lining, handkerchief, and hands and face all about the nose and mouth were shown to be heavily contaminated.

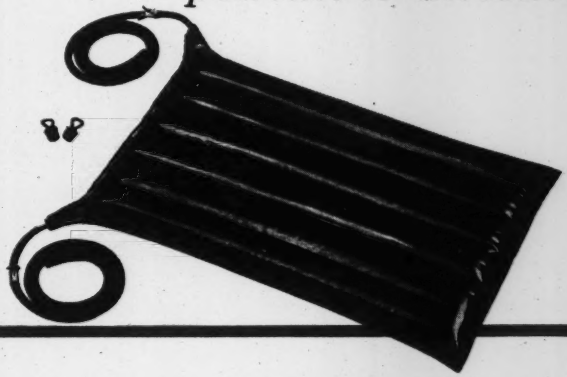
The interesting fact was mentioned that "so long as they remain in the nose, they (staphylococci) are of no significance is the spread of illness. It has been shown that very few staphylococci are expelled from the nasopharynx during respiration, yet the hands and clothing of nasal 'carriers' (of staphylococci) are frequently very heavily infected. Many more organisms are released into the air as the result of the movement of infected clothing than by a sneeze." The authors urged, therefore, that personnel with colds use only paper handkerchiefs (and use them only once!), and that they meticulously wash their hands after each use. They also stated that no employee with an active infection (e.g., a boil, etc.) should be allowed to work.

In this connection, there is a very significant remark by Dr. Hugh Starkey of Montreal in another paper:

"The regular ward staff actively engaged in treating patients is usually well controlled by nurses-in-charge or by senior doctors, but *members of the many ancillary services that have increased greatly in the last 20 years are not usually trained as strictly*. Responsibility for keeping various special technicians, such as physiotherapists, occupational therapists and social service workers, away from patients when these staff members have active infections must be fully appreciated by those in charge of such services."

concluded on page 36

improved
temperature control in
*pediatric anesthesia**



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**Body Temperatures during Anesthesia in Infants and Children: Bigler, John A., and McQuiston, William Otis, AMA Jl. June 9, 1951: 551-556 . . . Indications for Cooling in Pediatric Anesthesia: Terry, Richard N., New York State Journal of Medicine, Jan. 1, 1957: 105-107.*

continued from page 34

(Italics are mine.) He might have said inhalation therapists too. In many hospitals this would undoubtedly be true.

It seems to me that now is a good time for the Association to appoint a committee to study the matters of:

(1) General standards of cleanliness for our quarters which we should insist our institutions maintain (or otherwise provide for ourselves). There are too many inhalation therapy departments that are relegated to a dirty basement area and then forgotten by the custodial staff!

(2) Acceptable methods for cleaning and sterilizing equipment of each type, and for packaging and storing until subsequent use.

(3) Recommendations for mask and gown precaution technique, and other procedures to be observed in special cases.

(4) Special decontamination and sterilization procedures for such equipment as tents, IPPB machines, flowmeters, etc., which are either too big or awkward to be autoclaved or would be damaged by this method.

A.M.A. Convention

For the first time, the AAIT was represented at the annual meeting of the American Medical Association in San Francisco in June.

The American College of Chest Physicians had a scientific exhibit on pulmonary function testing and the treatment of chronic lung disease. Three AAIT members were invited to participate by demonstrating IPPB and aerosol equipment to doctors visiting the booth.

The therapists learned a lot, and so did many visitors, who were unfamiliar with the apparatus and wanted to find out what it could do. Many seemed very pleasantly surprised—well, at least impressed—that there are therapists available some places who are qualified and eager to help them with therapy for their pulmonary cases.

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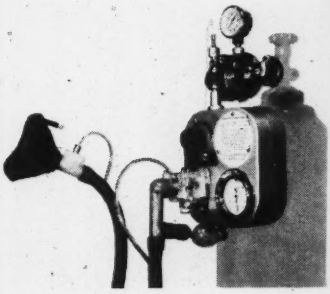

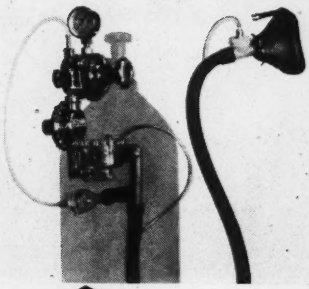

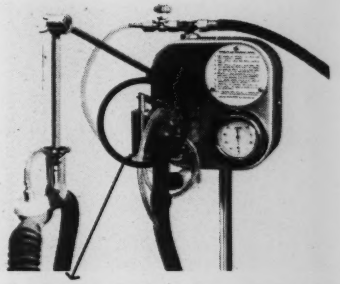

COMPACT RATE CONTROL ATTACHMENT is used as an Assistor-Controller mechanism for either DOTCO Respirators or the Deep Breather unit. It is adjusted to cycle at slower-than-normal patient breathing rate. If the patient does not make a breathing effort within the adjusted time cycle, the rate control attachment will initiate a breathing cycle.

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ABSTRACTS

"Alveolar CO_2 Measurements in Normal and Emphysematous Subjects," by James E. Kelsey, M.D., E. C. Oldham, M.S., and Steven Horvath, Ph.D., in *A.M.A. Arch. Int. Med.*, **99**:411, 1957.

These investigators contend that the emphysematous person's respiratory center is *not* depressed and insensitive to CO_2, and that, if anything, it is *more* sensitive to CO_2 than the normal person's. They say that the reason why, on breathing 7.5% CO_2 in O_2 the emphysematous person only doubles his minute volume, whereas the normal person triples his, is that the emphysematous person's rib cage is fixed and his lungs less elastic than those of normal individuals.

They arrived at this conclusion from studies in which they correlated results of standard pulmonary function tests (vital capacity, maximum ventilatory volume, etc.) with analyses of alveolar CO_2 concentrations made before, during and after the tests.

AAIT

"Pulmonary Ventilation Function Tests in Allergy Practice," by H. Beecher Chapin, M.D., in *N.Y. State J. Med.* **58**:891, 1958.

This is a beautifully organized paper, in which Dr. Chapin neatly divides respiration into the mechanical or ventilatory phase and the chemical-physiological phase, shows how most of the difficulties we deal with in patients with respiratory illnesses are of the ventilatory type—i.e., they *present* with this type of difficulty before the other type becomes evident usually. He goes on to show that the disorders of the ventilation phase are either of *restrictive* or *obstructive* nature, and that the commonest ones are obstructive. He then discusses pulmonary function tests which are of value in revealing the type and extent of obstruction the patient has. These are chiefly the vital capacity, timed vital capacity and maximum breathing capacity, which he describes in some detail.

While this presentation is directed at the allergist who might be doing these tests in his office, the information is so concisely stated as to be of great use to anybody interested. He closes with the point that proper equipment and training of personnel who use it is essential for good results.

AAIT

"Respiratory Function in Postoperative Patients," by Mastis and Albritten, in *A.M.A. Archives of Surgery*, **76**:732, 1958.

Pre-operative values for arterial oxygen saturation, pCO_2, pH, etc. were determined for the patients in this study. Then immediately after their operation, the same determinations were repeated before removing the endotracheal tube used for anesthesia. The procedures were repeated again in the recovery room, and once more in the patients' rooms the following morning. The tests in the recovery room and patients' rooms were made before and after narcotics were given for pain.

Postoperatively the patients were found to have arterial oxygen saturation below normal, and abnormally high CO_2 values leading to acidosis. During the operation, the patient's ventilation is supervised by the anesthetist, but after he is disconnected from the anesthesia machine, post-anesthetic and post-operative depression and pain both conduce to shallow, ineffective respirations. These result in the hypoxic state and CO_2 retention which these measurements revealed.

It has long been known that narcotics are respiratory depressants, and it has hence been argued that they should not be used because the patient is already under ventilated and the narcotics will increase this effect. But pain is also a depressant, and evidently a very potent one; because the interesting finding which emerged is that while poorly-timed or too large doses of narcotics will worsen the condition just described, just *average* doses will *improve* it, if well-timed, by relieving the pain which inhibits effective respiratory efforts. The patient then exchanges a better volume of air and returns more quickly to normal oxygen and CO_2 values.

continued on page 42

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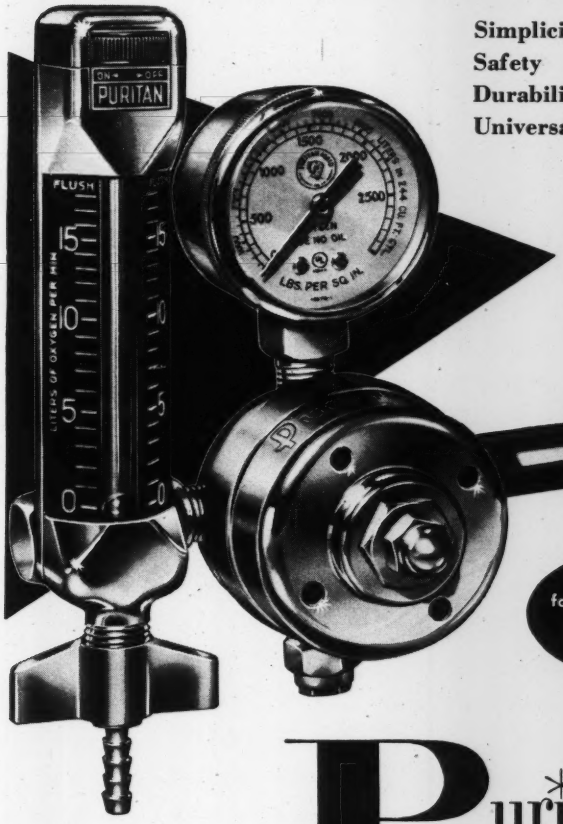

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continued from page 21

Proper records also effectively eliminate loss. Running inventories which show the location at all times of every piece of equipment (pressure regulators, humidifiers, nebulizers, etc.) insure that none of your vital "tools" can go astray.

A convincing argument against the further purchase of inferior short-life equipment, such as tent canopies, can be made by maintaining a "use record" noting the number of patient hours obtained before the canopy had to be discarded. Again referring to our experience at the University of Michigan Medical Center, we were paying $12.00 each for fairly good tent canopies. We found a competitor who would make a better canopy of heavier material for $7.00 each. We were able to realize a double saving; a lower price and more than twice as many patient hours for each canopy.

And, finally, good maintenance of all equipment, of course, is one of the best ways of plugging the budget leaks. For this a small set of tools is necessary—i.e., small socket wrench set, Phillips screw drivers, a set of box-end wrenches to 1¾", screw drivers, small nose pliers, and a bench vise. Simple adjustments, tightening of screws and bolts, more complete disassembling of equipment for cleaning are then possible.

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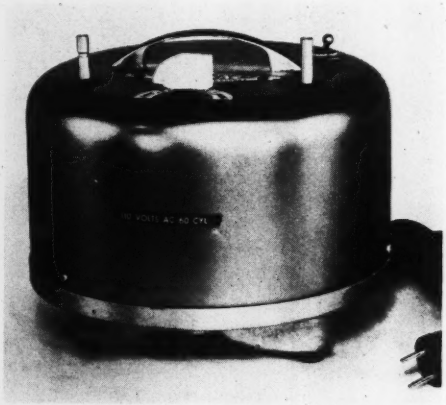

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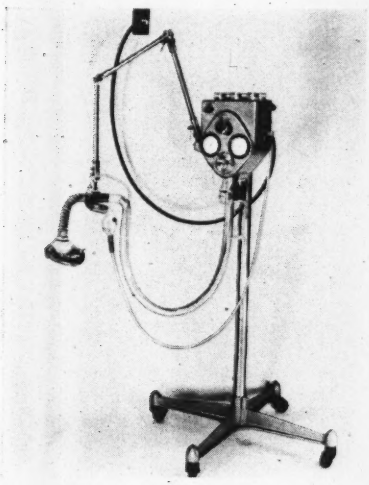
When used for intermittent positive pressure breathing therapy, the mobile instrument matches in function the familiar Bennett TV-2P and PV-3P units.



By a simple setting of an automatic cycling rate control, the PR-1A Unit maintains or insures respiration when used as a resuscitator or respirator. Because of the flow-sensitivity of the Bennett valve, the cycling mechanism does not interfere with the activation of the valve by normal respiratory effort. Even during automatic operation, the patient can take over and breathe his own pattern without being blocked or restricted. The respirator will again cycle automatically if the patient stops breathing or slows his breathing below the set cycling rate. This characteristic is especially significant when the PR-1A is used on a patient who has some respiratory function, but who is not coordinating well.

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directly between the wheels, making it virtually impossible to upset the unit.

The carrier is moved or turned by gentle pressure on the upper part of the cylinder itself. To place a cylinder on the cart or remove it, the nurse or attendant simply raises the rear casters until the base plate is at floor level.

No. 332

continued from page 38

"Tracheal Constriction in the Dog," by Loofbourrow, Wood and Baird, in *Am. J. Physiol.* **191**:411, 1957.

As early as 1892, Einthoven reported that the bronchi constrict when CO_2 is inhaled, and that this reaction does not occur if the vagus nerves have been cut. Not many investigators have paid attention to this early observation until the present group at University of Kansas got interested in contractions of the trachea.

Their work was done on nembutal-anesthetized dogs, in which they inserted a balloon into the trachea and recorded changes in air pressure in the balloon caused by squeezing action of the trachea as it constricted. Several series of interesting experiments were done with animals prepared in this way, and in some they used open chest preparations in which ventilation was maintained artificially with pumps.

The findings are that the trachea reflexly constricts proportionately to (1) the amount of CO_2 in the inspired air, and/or (2) to the lack of stretching of the lungs—a condition which is a feature of insufficient ventilation. In this case, the animal would not be getting rid of enough CO_2, so that even though the inspired concentration is not high, it is building up in the lungs because of inadequate removal.

The constriction of the trachea, which is always greater if lungs are relatively deflated than when they are nearly full, can be promptly alleviated by inflating the lungs with fresh air. To prove that the relaxation of the trachea was not caused by restoring *oxygen* supply, they reinflated the lungs with nitrogen and got the same result.

The reflex is mediated via the vagus nerves—partly from stretch receptors in the lungs, and partly from direct effects of CO_2. There is also evidence of intrinsic response of the tracheal musculature itself (as demonstrated after the vagi are cut, and in experiments with isolated sections of the trachea).

The full significance of this mechanism is not yet understood, but they feel it is quite reasonable to advance the idea that this is a device for automatically reducing the dead space (which, of course, it effectively does) whenever the body is faced with inadequate ventilation or increasing pCO_2 in the inspired air. Reducing the dead space is one way of improving the elimination of CO_2 from the lungs.

AAIT

"Aerosolized Steroids in Bronchial Asthma," by Franklin, Lowell, Michelson & Schiller, in *J. Allergy*, **29**:214, 1958.

Prednisolone suspended in Freon ("Medi-haler-Cort," Riker Co.) was tried with considerable success in treatment of asthma in a series of patients in a double-blind study. The authors also tried aerosolized hydrocortisone in an uncontrolled study, and think it was effective too. The chief problem they encountered was the coarse spray of the Medi-haler nebulizer, which deposits too much in the mouth and throat. They got around this objection by adding a 14" plastic tube of large bore, which would catch large particles and leave only the smaller ones to enter the airway.

The impression is that this topical application technique of steroid hormones is not only effective, but also is to be recommended for two other reasons: (1) economy—much less steroid is used; and (2) less management difficulty of the sort arising from hypersteroidism which accompanies larger, systemic dosage.

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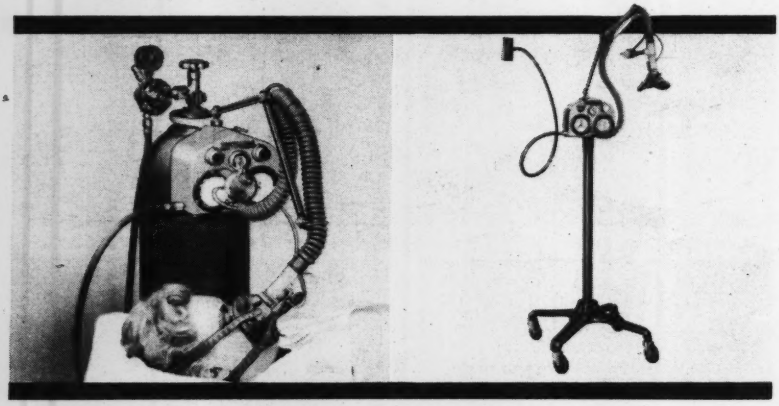

At left, VENTALUNG with Auto-cycler used with cylinder oxygen.
At right, VENTALUNG on carrier for use with piped oxygen.

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